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August 3, 2009

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

***Re: WT Docket No. 07-293; Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band***

Dear Ms. Dortch:

On July 28 and 29, Sirius XM Radio Inc ("Sirius XM") participated in a series of engineering tests and demonstrations with WCS Coalition members to show the scope and nature of potential interference to satellite radio reception from WCS devices. Commission staff members from the Office of Engineering and Technology, the International Bureau, and the Wireless Telecommunications Bureau also participated in the sessions.[1] This letter summarizes the results of these tests and demonstrations and provides recommended next steps for resolving these long-standing issues.[2]

The tests and demonstrations performed last week validate the results of similar tests performed by independent, third-party test labs that Sirius XM submitted into the record earlier this year.[3] Even in a geographic location that receives some of the strongest satellite radio signals in the country and that had little foliage and few other obstructions to weaken satellite

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1 The list of participants from Sirius XM and the FCC is attached to this letter.

2 Although these sessions were designed to demonstrate interference that mobile WCS operations would create to satellite radio, the Commission has linked WT Docket No. 07-93 with IB Docket No. 95-91, the long-pending proceeding addressing Sirius XM's need to use terrestrial repeaters under Part 25. To the extent last week's WCS interference demonstrations may assist the Commission in resolving WT Docket No. 07-93, they will also permit resolution of the far less controversial issues that have delayed the completion of IB Docket No. 95-91 for more than a decade.

3 *See*, Letter from Terrence R. Smith, Corporate Vice President and Chief Engineering Officer, and James S. Blitz, Vice President, Regulatory Counsel, Sirius XM Radio, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 07-293, submitted February 27, 2009.

reception, the WCS mobile device that was tested still interfered with satellite radio service. While the demonstrations may have uncovered some common ground to allow some mobile use of the WCS spectrum, it remains clear that such use must be controlled and limited to certain technologies and test cases that can be demonstrated not to prevent satellite radio reception.

**Background and Test Set-Up.** The demonstration and engineering tests were conducted in Ashburn, Virginia in parking lots adjacent to 44675 Cape Court and 44610 Waxpool Road, and inside the hotel at the latter location. The FCC previously provided public notice of the event and invited members of the public and other interested parties to observe.[4]

On the first day of testing, the WCS Coalition attempted to demonstrate the potential for interference to satellite radio reception from a prototype WCS laptop modem using WiMAX technology. The WCS device communicated with a single WiMAX base station transmitter located on top of a nearby building. The base station had a limited coverage area of a few blocks due to its single sector operation, low transmit power, and low height above ground.

The laptop modem – essentially a PC PCMCIA adapter – was attached to and controlled by a laptop computer operated by a WCS engineering consultant that used specialized software to modify key transmitting parameters such as frequency, data rates, and the power control algorithm. The laptop modem and the person controlling it were in a vehicle that was repeatedly driven over an established route in close proximity to another vehicle outfitted with Sirius XM aftermarket and OEM receivers. The WCS Coalition had defined approximately 30 test cases having varying operating parameters and orientation of the laptop, but, based on feedback from Commission staff, a smaller subset of these 30 test cases was actually performed. Static tests were also performed at the request of the FCC staff, where the WiMAX modem was held at various distances from the satellite radio antenna to more fully show the interference distances at various operation configurations.

Day two was led by a team of engineers from Sirius XM. Rather than the more limited WCS demonstration, Sirius XM conducted its test by emulating WCS transmissions that complied with the operational rules the WCS Coalition has proposed in this proceeding. This WCS transmitter used signal generators, spectrum analyzers, filters, and power supplies capable of simulating the proposed emissions in the WCS A, B, C, and D blocks.[5] The test equipment was placed in a parked car. The test equipment allowed for easy and transparent adjustment of key WCS operating parameters by those in attendance, including adjustments to operating frequency, power, duty cycle (*i.e.*, data transmission rate) and out-of-band emission ("OOBE") suppression. A vehicle equipped with a Sirius XM OEM receiver was located next to the vehicle with the mobile WCS transmitter.

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[4] *The FCC's Office of Engineering and Technology Announces WCS Coalition and Sirius XM Demo Tests*, Public Notice, DA 09-1608 (July 24, 2009).

[5] In the attached Engineering Appendix, Sirius XM provides an engineering report with greater detail on its test set-up and results of its demonstrations and tests.

In each case, satellite radio reception was totally muted when the vehicles were adjacent. The vehicle receiving satellite radio was then driven away from the mobile transmitter until the muting caused by WCS interference was eliminated. In each scenario, Sirius XM recorded the separation distance between the two vehicles when the interference ceased and the satellite radio signal returned. Although the tests were intended to show WCS interference to satellite-based transmissions only, Sirius XM conducted its test in the presence of a terrestrial repeater having significant signal strength. At one point during the demonstration, Sirius XM personnel contacted its network operations to turn off the nearby terrestrial repeater for comparison purposes. Also, at the request of FCC staff, Sirius XM maneuvered its test vehicle so that reception of one of the two XM network satellites was obstructed by a nearby building. The FCC also requested that the WCS Coalition provide one of its test vehicles with an OEM-installed Sirius XM receiver used for the previous day's testing to compare results under the single satellite reception scenario. These tests were conducted to compare the results to tests where the satellite receiver was able to obtain signals from both operating XM satellites.[6]

After completing its parking lot tests, Sirius XM relocated and calibrated the test equipment indoors to permit further testing in a more controlled and repeatable environment. This indoor testing allowed those present to see a visual and audio display of interference caused by varying parameters of WiMAX transmissions originating in the WCS band. Numerous adjustments were made to the emulated WCS transmissions, and the results were recorded – a scenario comparable to the joint testing process that Sirius proposed over a year ago.[7]

**<u>Results and Observations</u>.** During the first day's demonstration, the WCS Coalition showed that a certain configuration of mobile WCS devices can be operated under specific usage patterns and cause only limited interference to satellite radio reception. While the operating parameters of the WCS transmitting devices were not fully transparent to observers, the prototype WCS mobile WiMAX device transmitted on WCS frequencies at a variety of operating powers and frequencies and generally did not mute satellite radio audio channel reception to the other test vehicle.

Numerous factors are relevant to determining the validity of the WCS Coalition's demonstration. First, they conducted the demonstration in an area of the country receiving the strongest possible signals from Sirius XM's satellites; other geographic regions receive signals as much as 6 dB lower than the mid-Atlantic area where the demonstrations were conducted. In addition, the test site had few obstructions (*e.g.*, foliage, buildings, or overpasses) that typically attenuate the received satellite signal. Also, the WCS Coalition said it was unable to attach an external antenna to the PC card which made it difficult to orient the transmitting device in a

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[6] To help mitigate the impact of brief satellite signal losses due to foliage and other obstructions, the Sirius and XM Radio constellations both provide service to subscribers using two satellites. This diversity of service delivery allows Sirius XM to provide uninterrupted service to subscribers. *See* Letter from James S. Blitz, Sirius XM Radio Inc., to Marlene H. Dortch, Secretary, FCC, at 8, WT Docket No. 07-293, IB Docket No. 95-91 (filed Sept. 8, 2008).

[7] *See e.g.*, Letter from Patrick L. Donnelly, Sirius Satellite Radio Inc. and James S. Blitz, XM Radio Inc., WT Docket No. 07-293, IB Docket No. 95-91 (filed May 19, 2008)

manner that properly mimics handheld and dashboard use cases. Finally, the WCS transmitter was the only interferer on this limited test network, allowing the single handset to transmit at lower power levels and burst rates than would be the case in a typical network with multiple simultaneous transmissions. Even with these limitations, during one test case demonstrated by the WCS Coalition, the prototype WCS mobile device did mute reception of the satellite radio signal in the neighboring vehicle. And in those cases where muting did not occur, the satellite radio signal reception was impaired from the WCS interference in the form of lowered signal to noise ratio and increased bit errors. In more typical conditions where the desired satellite signal strength would be lower than at the demonstration site, the WCS interference would leave the satellite radio signal with less service margin to mitigate other fading effects.

In contrast to the first day's limited case demonstration, Sirius XM proved how different mobile WCS configurations and use cases – cases that would be allowed under the WCS Coalition's proposed rules – cause devastating interference to satellite radio reception even at extreme separation distances and even in the presence of a terrestrial repeater.[8] In fact, the testing that Sirius XM conducted showed that transmissions originating on all WCS spectrum blocks caused muting of satellite radio reception at distances at more than 25 meters between transmitter and receiver, even in the presence of a terrestrial repeater signal. This result is clearly unacceptable and would lead to massive disruption and frustration to Sirius XM's over 18 million subscribers, due to a total loss of service at unexpected times and places, lasting for as long as their vehicle is within proximity of a mobile WCS transmitter.

The dramatically different results between day one and two should not be surprising and, in fact, are precisely what Sirius XM predicted would occur when it first commented on the proposed structure and parameters of the demonstrations almost three months ago.[9] Not unexpectedly, the WCS Coalition selected a set-up and demonstration that provided the best-case scenario for what they hoped to show – *i.e.*, the lowest possible levels of interference to satellite radio service. However, Sirius XM proved that a more generic WCS transmission configuration -- well within the rule parameters proposed by the WCS Coalition -- would cause devastating interference to satellite radio reception. Moreover, Sirius XM conducted its tests with full transparency where all parties had the full opportunity to examine and adjust the equipment.

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[8] If sufficiently strong, signals from a terrestrial signals could be expected to mitigate interference from WCS devices. Last week's results indicate that the presence of repeaters should not form the basis of a regulatory structure governing satellite radio and WCS compatibility. Furthermore, Sirius XM's terrestrial repeaters cover less than 1% of the land area of the United States.

[9] Letter from James S. Blitz, Sirius XM Radio Inc., WT Docket No. 07-293 (filed May 6, 2009) ("Under the parameters proposed by the WCS Coalition demonstration plan, Sirius XM fully expects that the demonstration will show only rare and limited interference conditions as a result of the specific demonstration setting. The results that can be expected from the Coalition's demonstration will not, however, contradict Sirius XM's road tests that showed severe interference to satellite radio reception from WCS devices.")

Assuming the WCS demonstration presented a valid depiction of the mobile device that the WCS licensees intend to operate under the proposed rules, the two days of demonstrations and tests nonetheless provide a clear path forward toward resolving this proceeding. Fundamentally, and consistent with the Commission's conclusion when it first established the WCS service,[10] the WCS Coalition failed to demonstrate that unrestricted mobile operations can be allowed in the WCS service without causing harmful interference to satellite radio service. Severe interference did occur in one of the WCS Coalition's demonstrations, and through Sirius XM's testing on Wednesday and in numerous filings in this docket, Sirius XM and third parties have provided ample evidence proving that destructive interference will result from unrestricted mobile WCS transmissions. Of course, under certain operational conditions and technology-specific transmission parameters, mobile WCS operations could operate without causing significant interference to satellite radio reception. That being the case, Sirius XM is prepared to work with the WCS Coalition and the FCC to identify and detail in the Commission's rules those mobile WCS operating parameters and usage restrictions that would protect Sirius XM's subscribers but still allow WCS licensees to introduce mobile WiMAX devices into the band, consistent with the WCS Coalition's demonstration last Tuesday.

**Next Steps and Recommendations.** With the FCC's leadership and guidance, Sirius XM believes that both sides should now be able to develop modified rules incorporating parameters that would need to be defined and controlled if additional operational flexibility is to be allowed in the WCS band. Based on the recent demonstrations, Sirius XM has identified the following parameters that should be the primary focus of further review and discussion:

- ***Operating Frequency*****:** The tests demonstrated that satellite radio reception is highly susceptible to interference from WCS transmissions that originate in the WCS C and D spectrum blocks. Mobile operations on these blocks should be prohibited or severely restricted including guard band, peak-to-average limits, and other conditions.
- ***Out-of-Band Emissions*****:** The WCS Coalition has pointed out on several occasions that FCC standards for OOBE suppression understate the protection that would be afforded to Sirius XM receivers because in the real world, the OOBE from WCS devices would constantly decay rather than simply satisfying any standard in the FCC's rules. The expected rate of decay should be defined and, if sufficient to protect Sirius XM reception, specified in modified rules.
- ***Transmitter Power*****:** The demonstrations confirmed that Sirius XM receivers are highly susceptible to overload interference. Transmitter power of WCS mobile devices must be limited to levels well below the proposed 250 milliwatts. WCS Coalition members have stated often that handsets rarely operate at those levels in any event due to power control operation.

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[10] *See* Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service, Report and Order, GN Docket No. 96-228, 12 FCC Rcd 10785, 10833 (1997). ("[T]he out-of-band emission limits we are adopting -- which we believe are necessary to protect prospective satellite DARS licensees from interference from WCS operations -- will, at least in the foreseeable future, make mobile operations in the WCS spectrum technologically infeasible.").

- ***Modulation Characteristics*****:** The process also showed that interference to satellite radio reception is highly dependent on duty cycle of the interfering signal and WiMAX burst rates. Consideration and limitation of these parameters should be included in any rules allowing WCS mobile use.
- ***Antenna Location*****:** The demonstrations also showed that use of external, roof-mounted antennas to expand WCS mobile range would have devastating impact on satellite radio. Such devices must be prohibited.

Finally, the WCS Coalition has focused all of its analysis and its demonstration on the compatibility of WiMAX based devices developed under the IEEE 802.16e committee. The spectrum and emissions profile of WiMAX differs significantly from other mobile technologies that could potentially be used in the WCS band. Therefore, Sirius XM believes that any additional flexibility the FCC may incorporate into its rules to allow for mobile WCS operations should be technology-specific and limited to the use of battery operated WiMAX devices that implement the current version of the IEEE 802.16e standard. Different limitations or factors beyond those identified above may need to be developed if other mobile technologies are allowed.

Sirius XM believes that the two days of tests and demonstrations in the presence of FCC staff were very productive and provide a clear path toward concluding the proceedings in WT Docket No. 07-293 and IB Docket 95-91. That path will allow WCS licensees to operate mobile transmitters in their band but only after detailed use restrictions are developed to limit mobile service to those scenarios that have adequately been demonstrated not to cause a destructive impact to satellite radio service.

Respectfully submitted,
Sirius XM Radio Inc.

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Attachment: List of Sirius XM and FCC Participants
Engineering Appendix: Summary of Field and Laboratory Tests to Determine WCS-SDARS Interference Limits

## Attachment – List of Sirius XM and FCC Participants

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3. Wireless Telecommunication Bureau

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**Engineering Appendix**

**Summary of Field and Laboratory Tests to Determine WCS-Satellite Radio Interference Limits**

## Introduction

Following the WCS Coalition's limited demonstration of a WiMAX network operating simultaneously with the Sirius and XM satellite radio systems, Sirius XM showed the interference that is created to satellite radio by WCS transmissions that would be permitted under the WCS Coalition's current Part 27 rule proposal.

These tests were conducted in Ashburn, Virginia on July 29th, 2009. In the morning, Sirius XM conducted field tests to demonstrate interference caused by portable and in-vehicle WCS transmissions to OEM installed satellite radio receivers in stationary and mobile conditions. In the afternoon, Sirius XM performed lab tests to demonstrate the interference a controlled and repeatable laboratory condition.

This interference was first tested with radiated signals in a parking lot, where WCS transmissions muted satellite radio reception at distances of more than 25 meters between the WCS interferer and the satellite radio equipped victim vehicle, in the presence of terrestrial repeater signals. These tests demonstrated the effects for handheld, laptop and dashboard installation use cases of the WCS terminals for satellite radio receivers installed with the OEM guidelines. Field tests started with a review of the test setup. Then, various conditions simulating interference to satellite radio receivers from portable and vehicular WCS interference were tested at the request of the FCC personnel.

Following the field portion of the test, Sirius XM configured a repeatable laboratory test environment in controlled conditions that demonstrated and provided factual data showing the power levels at which interference occurs due to WCS emissions. These test procedures have been published extensively by Sirius XM and various third parties in filings in this docket. The lab testing started with a review of the test equipment. Then, during the lab testing, participants measured the WCS interference levels that caused audio muting of the satellite radios in conditions representing operation in clear line of sight to the satellites.

Both the field and laboratory tests were structured as interactive events which allowed the participants to adjust individual parameters such as WCS power, frequency, and Out-of-Band emissions ("OOBE"), and answered any questions with actual measurement examples.

The following sections of this appendix present results from the laboratory and field portions of these tests.

## Field Test Configuration and Results

The first test conducted was a field test to demonstrate the distance at which muting occurs when transmitting a WiMAX signals at levels permissible under the current Part 27 rule proposal. Figure 1 shows a diagram of the transmitter test configuration, which is identical to the setup used to generate test results as shown in previous filings.[1]

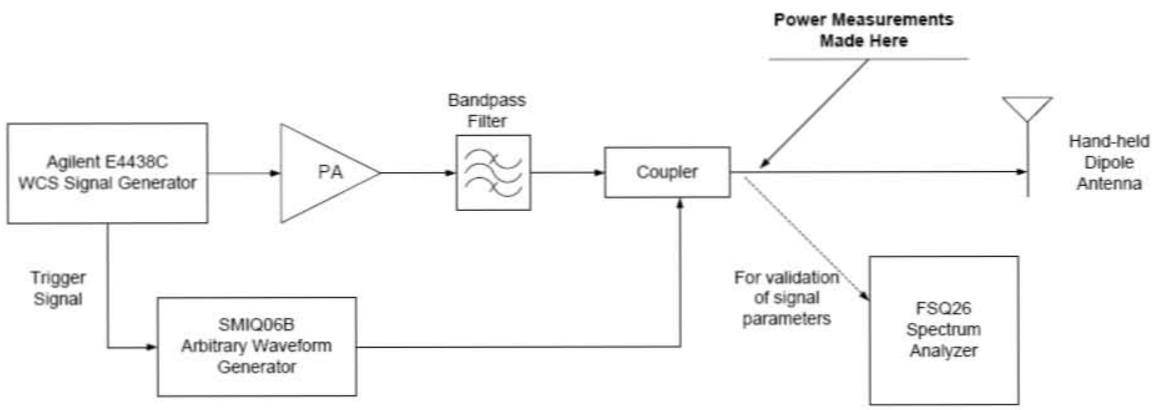


**Figure 1: WCS Transmitter Setup**

The tested WCS transmitter setup consists of an Agilent mobile WiMAX signal generator (Agilent ESG4433C), amplifier (Stealth Microwave SM2025-44L), a WCS channel filter, an AWGN noise generator (SMIQ-06), coupler, and WCS transmitter antenna and required cabling. The signal generator output fed the power amplifier, whose output is then fed into a band pass filter (selected by WCS Block) which is in turn connected to the antenna. The radiated interference signal levels was then adjusted to achieve the tested WCS interferer transmit power level. The antenna is a dipole with an overall antenna gain of 0 dBi toward the horizon. After the amplifier, the AWGN noise source was coupled to the transmitted signal and the level adjusted to match the desired WCS OOBE mask. The WiMAX generator provided a trigger signal to the SMIQ-06 to synchronize the noise and WiMAX bursts.

The WCS transmitter simulated the emission levels proposed by the WCS Coalition for the D-block. Specifically, the center frequency was 2347.5 MHz, with a 150 mW transmit power, and 56 + 10logP OOBE noise mask (equivalent to < -25 dBm/MHz) in the satellite radio spectrum. This power was measured using an RMS detector and referenced to the output power at 100% duty cycle. This results in a power rating that captures the average of the transmitter on-time power. Alternative methods of defining average power may average burst power over time, which results in lower average power but also allows significantly higher power to be transmitted in a burst.

[1] *See*, Letter from Terrence R. Smith, Corporate Vice President and Chief Engineering Officer, and James S. Blitz, Vice President, Regulatory Counsel, Sirius XM Radio, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 07-293, submitted February 27, 2009 at Exhibit 2 ("SWRI Test Results"). *See also,* Letter from Robert L. Pettit, Counsel for Sirius XM Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 07-293, February 09, 2008.

Figure2 shows the transmitter power profile measured at the antenna input (for both WCS and OOB power). The baseline D-block transmitter spectrum in Figure 2 shows the WCS channel power to be 21.7 dBm, with the adjacent power in the first 1 MHz of the XM Radio band measured at -25.4 dBm/MHz that is equivalent to a 56+10log(P) mask. In this figure, and the following spectrum plots, the WCS transmitter was set to a 100% duty cycle which allowed a clear plot to be captured.

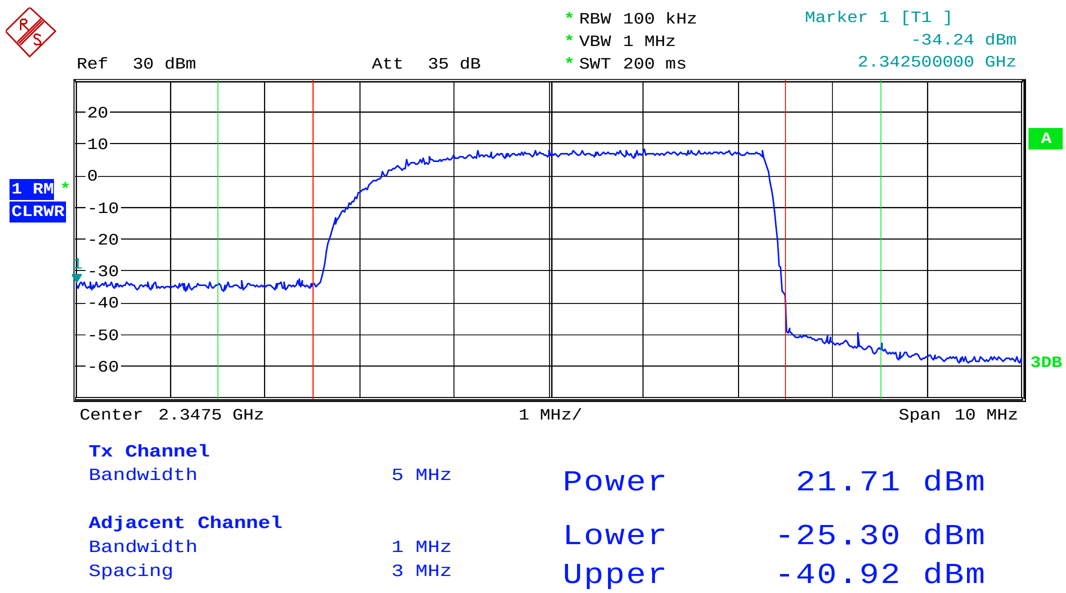


**Figure 2: D-block Transmitter at 2347.5 MHz Center Frequency**

During the course of the test, FCC staff requested that the center frequency be shifted away from the satellite radio band edge to simulate a guard band condition. Figures 3-6 show the resulting spectra from shifting the WCS center frequency away from the satellite radio band edge.

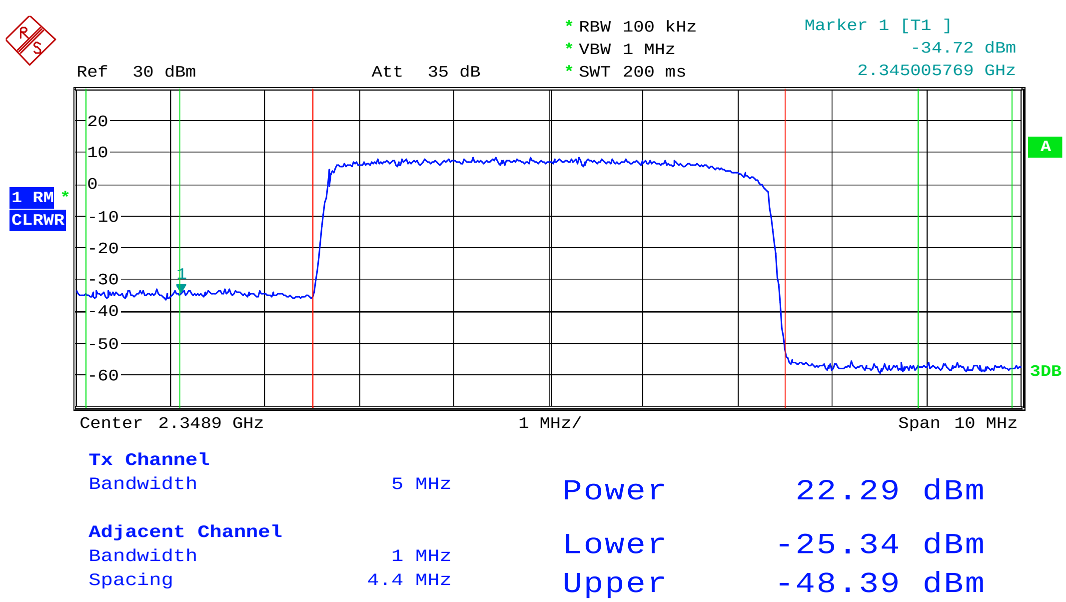

Figure 3: D-block Transmitter Shifted +1.4 MHz

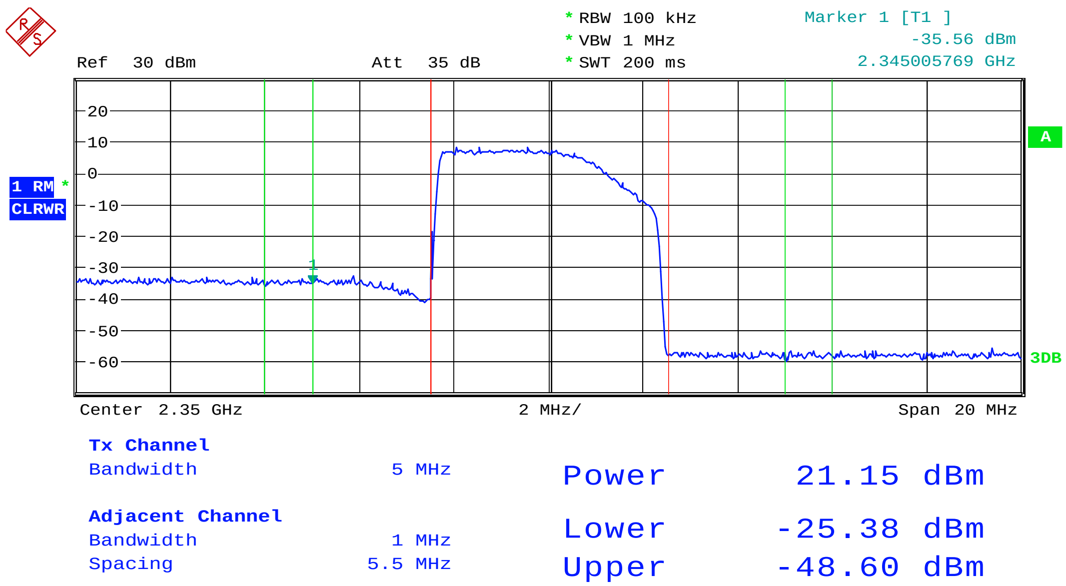


Figure 4: D-block Transmitter Shifted +2.5 MHz

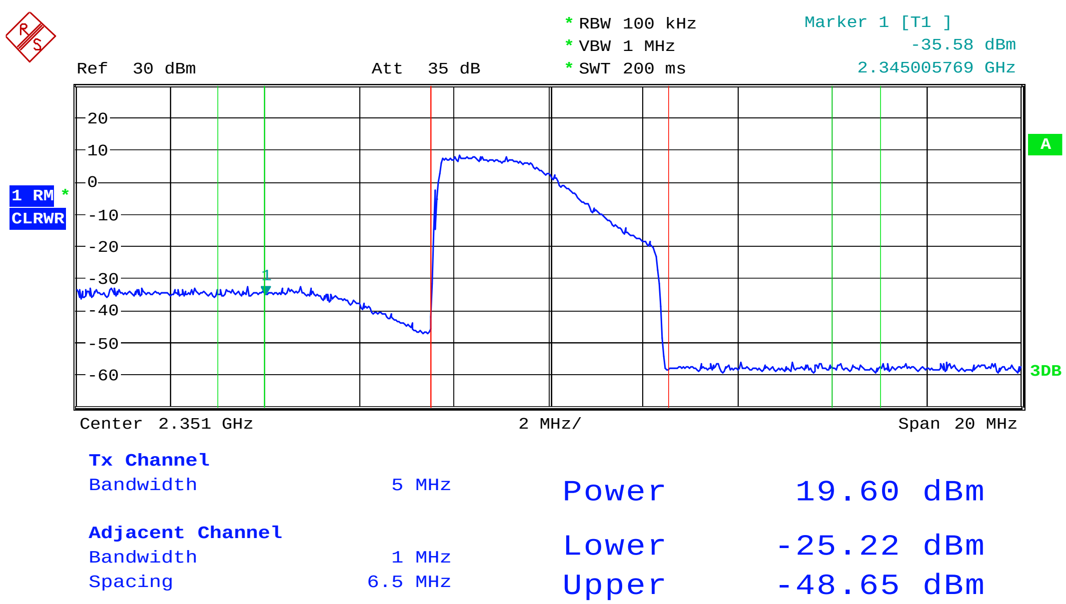


Figure 5: D-block Transmitter Shifted +3.5 MHz

Figure 5 shows the effect of the D-block band-pass-filter (BPF) as it attenuates the upper frequencies, resulting in approximately 1 dB of total channel power loss.

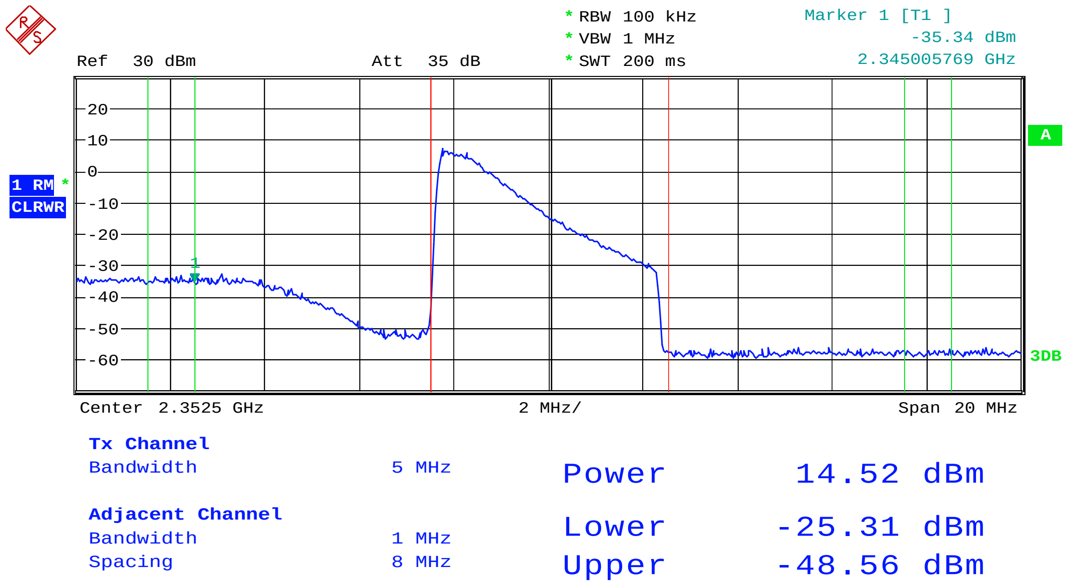


**Figure 6: D-block Transmitter Shifted to A-block (upper)**

Shifting the D-block signal all the way to the A-block (a +5 MHz shift) results in approximately 7 dB of channel power loss as seen in Figure 6. This is due to the D-block BPF attenuating the A-block frequencies. This configuration was only used for a field demonstration. In the laboratory setting, a properly tuned A-block BPF was used.

The victim satellite radio equipped vehicle in this case was a GM vehicle with factory installed XM radio. With the WCS emitter active, the satellite radio equipped vehicle was driven away from and toward the emitter to determine the distances at which interference occurred. In order to show the effects of OOBE roll-off, the field tests employed an OOBE mask of 56+10log(P) instead of a more stringent 56+10log(P).

Figures from 7 to 10 show the mobile field test setup where various distances of interference from the WCS transmitter to a vehicles provided by Sirius XM and the WCS Coalition with OEM and aftermarket installed satellite radios were demonstrated.

Figure 7: Picture of the mobile field test setup

Figure 8: Picture of the mobile field test setup with inspecting FCC engineers

**Figure 7: Picture of the mobile interference field test where various distances of interference was demonstrated from the WCS transmitter to a vehicle with an OEM installed satellite radio**

Figure 10: Picture of another field test setup where various cases of interference was demonstrated from the WCS transmitter to a vehicle provided by the WCS Coalition

The WCS transmitter was transmitting in the D-band and interfering with an OEM installed XM receiver at more than 25 meters when the WCS transmitter was located outside and inside a car. Lower burst rates at 6% caused the audio muting interference distance to be 20 meters and 13 meters when the interferer was located outside and inside the car, respectively.

Observed interference distances are listed in the following for the test cases when the WCS interferer was transmitting inside a vehicle and interfering with a factory-installed satellite radio receiver.

**WCS D-band with 56 + 10*Log P OOBE**

| Test | Duty-cycle | antenna position | direction of car | distance to reacquire |
|---|---|---|---|---|
| 0 | 25.00% | right ear | driving away | 28m |
| 1 | 25.00% | right ear | driving towards | 17m |
| 2 | 6.00% | right ear | driving away | 20m |
| 3 | 6.00% | right ear | driving towards | 13m |
| 4 | 12.50% | right ear | driving away | 16m |
| 5 | 12.50% | right ear | driving towards | 14m |

### Laboratory Test Configuration and Results

For the laboratory portion of our tests, satellite signals were generated at levels of -99 dBm per satellite channel. WCS and white (Gaussian) noise signals emulating the WCS OOB emissions were also generated, attenuated, and coupled into the satellite signal. All signal frequencies and power levels were verified using a calibrated spectrum analyzer. Attenuation was adjusted in order to determine the minimum attenuation setting (maximum signal power) that the satellite receiver could tolerate without muting. The test setup is shown in Figure 11 below[2] and the setup is also shown in a picture in Figure 12.

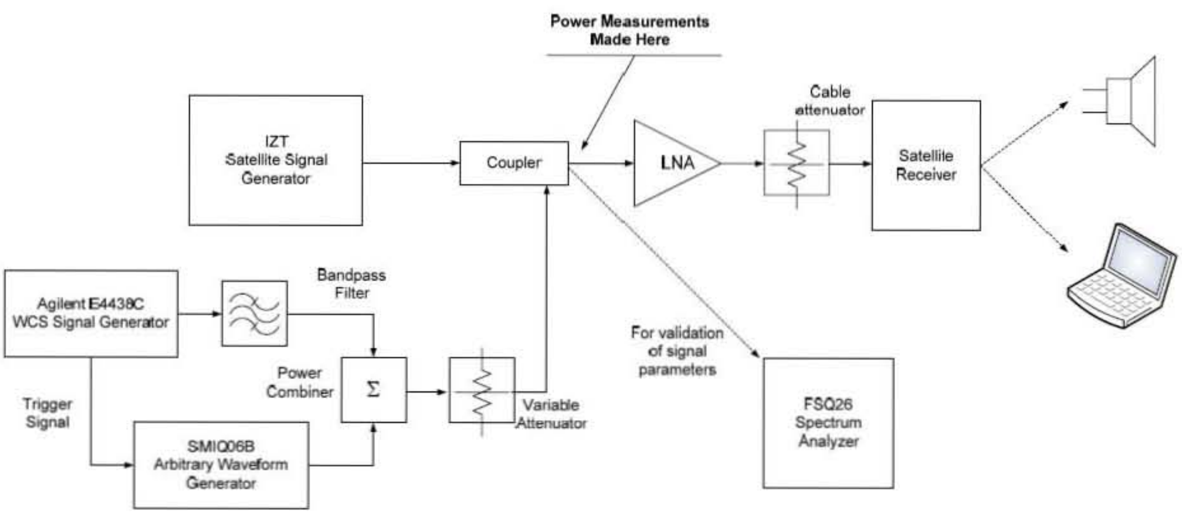

Figure 11: Diagram of the Laboratory Test Setup

[2] SWRI Test Results at Exhibit 2.

Figure 12: Picture of the Laboratory Test Setup

The tests were run with an initial WCS output power level of -30 dBm, representing expected WCS output powers of +22dBm with 52 dB of path loss (based on the path loss measured at 3 m separation distance between the WCS transmit and Sirius XM receive antennas).[3] These values represent average power during a burst, thus the peak power is higher due to the crest factor of the WCS signal, and the overall average power is lower due to the duty cycle.

The SMIQ06B was used to generate white noise outside of the WCS band in the Satellite Radio bands to represent the WCS OOBE mask. Bandpass filters were used to ensure that the WCS signal generator did not add any further noise in these bands. The noise level was set to -77dBm per 1 MHz bandwidth, corresponding to -25 dBm per 1 MHz with 52 dB of path loss. This corresponds to a 55 + 10 log( P ) spectral mask (where P is in Watts) at the transmitter. For each tests, the minimum attenuation (maximum WCS received signal power) level which would allow un-muted audio playback was recorded.

Exhibit A below presents the recorded test results for the baseline cases envisioned by Sirius XM (D block, A block WCS interferers) as well as the test cases requested by FCC [and WCS?] engineers to

[3] SWRI Test Results at Exhibit 1.

include various duty cycle, satellite signal, and overload/OOB configurations. All reported laboratory tests were conducted using an XM aftermarket receiver (i.e., the RoadyXT) which is typical of aftermarket receivers used by Sirius XM subscribers.

Exhibit B below shows the frequency response of the WCS channel band-pass-filters used for this test.

**Summary and Conclusions**

During the field portion of its testing, Sirius XM demonstrated that WCS signals created significant interference at large distances when configured in accordance with waveforms allowable under proposed Part 27 rules. In this case, the WCS transmitter operating in the D-band caused muting interference to an OEM-installed XM receiver at more than 25 meters when the WCS transmitter was located outside and inside a car, even in the presence of a satellite radio terrestrial repeater. Lower burst rates at 6% caused the audio muting interference distance to be 20 meters and 13 meters when the interferer was located outside and inside the car, respectively.

The test location had high satellite signal levels as compared to the other parts of the country and the tests were ran in the clear line of sight to the satellites without other impairments that would worsen the test results by increasing the interference distances significantly. We observed significantly higher levels of interference to satellite radio from WCS transmissions in the D-block, which is adjacent to the XM Radio band. Introducing a guard band by shifting the frequency away from the band edge provided some reduction in the interference distances.

The laboratory tests, similar to the field tests, fundamentally agreed with previous Sirius XM filings documenting the levels at which WCS signals interfere with satellite radio transmissions. The laboratory testing showed that D-block signals significantly affected satellite radio transmissions at low levels. As in the field tests, using a guard band, operating in the A-upper block, and restricting duty cycle were shown to provide some improvement in the satellite radio interference response.

**Exhibit A: Laboratory Test Results**

| WCS-Satellite Radio Interference Laboratory Test Results | |
|---|---|
| Date | 7/29/2009 |
| Location | Ashburn, VA |

| Baseline Values @ 0 dB Attenuation | | |
|---|---|---|
| WCS Power at Satellite Radio Receiver: | -30 | dBm |
| WCS OOB Power in Satellite Radio Band | -77 | dBm/MHz |

| **Case 1** | | | |
|---|---|---|---|
| Receiver | XM Roady XT | | |
| XM Signal | Ensemble B | | |
| Satellite Signal Power (Ensemble) | -99 dBm | | |
| WCS Freq | D-block (2347.5 MHz) | | |
| WCS Channel BW | 5 MHz (nominal, before filter effects) | | |
| WiMAX Duty Cycle | 25% | | |
| Scenario | Attenuation Required to Play Audio (dB) | Equivalent WCS Channel Power at Satellite Radio Receiver (dBm) | Equivalent WCS OOB Power at Satellite Radio Receiver (dBm/MHz) |
| Dual Satellites, WCS and OOB Power | 35 | -65 | -112 |
| Outer Satellite, WCS and OOB Power | 41 | -71 | -118 |
| Inner Satellite, WCS and OOB Power | 40 | -70 | -117 |

| Case 2 | | | |
|---|---|---|---|
| WCS Center Freq. 2350 MHz (Shifted +2.5 MHz, No Filter Change)<br>WiMAX Duty Cycle 6%<br>All other parameters equal to Case 1 | | | |
| Scenario | Attenuation Required to Play Audio (dB) | Equivalent WCS Channel Power at Satellite Radio Receiver (dBm) | Equivalent WCS OOB Power at Satellite Radio Receiver (dBm/MHz) |
| Dual Satellites, WCS and OOB Power | 12 | -42 | -89 |

| Case 3 | | | |
|---|---|---|---|
| WCS Center Freq. 2350 MHz (Shifted +2.5 MHz, No Filter Change)<br>WiMAX Duty Cycle 25%<br>All other parameters equal to Case 2 | | | |
| Scenario | Attenuation Required to Play Audio (dB) | Equivalent WCS Channel Power at Satellite Radio Receiver (dBm) | Equivalent WCS OOB Power at Satellite Radio Receiver (dBm/MHz) |
| Dual Satellites, WCS and OOB Power | 26 | -56 | -103 |

| **Case 4** | | | |
|---|---|---|---|
| WCS Center Freq. | 2350 MHz | (Shifted +2.5 MHz, No Filter Change) | |
| WiMAX Duty Cycle | 12% | | |
| All other parameters equal to Case 2 | | | |
| Scenario | Attenuation Required to Play Audio (dB) | Equivalent WCS Channel Power at Satellite Radio Receiver (dBm) | Equivalent WCS OOB Power at Satellite Radio Receiver (dBm/MHz) |
| Dual Satellites, WCS and OOB Power | 14 | -44 | -91 |
| Outer Sat, WCS + OOB | 20 | -50 | -97 |
| Inner Sat, WCS + OOB | 19 | -49 | -96 |

| **Case 5** | | | |
|---|---|---|---|
| WCS Center Freq. | 2352.5 MHz | (With Filter Change) | |
| WiMAX Duty Cycle | 25% | | |
| Scenario | Attenuation Required to Play Audio (dB) | Equivalent WCS Channel Power at Satellite Radio Receiver (dBm) | Equivalent WCS OOB Power at Satellite Radio Receiver (dBm/MHz) |
| Dual Satellites, WCS and OOB Power | 16 | -46 | -93 |

**Case 6**

| WCS Center Freq. | 2352.5 MHz | (With Filter Change) | |
|---|---|---|---|
| WiMAX Duty Cycle | 12% | | |

| Scenario | Attenuation Required to Play Audio (dB) | Equivalent WCS Channel Power at Satellite Radio Receiver (dBm) | Equivalent WCS OOB Power at Satellite Radio Receiver (dBm/MHz) |
|---|---|---|---|
| Dual Satellites, WCS and OOB Power | 10 | -40 | -87 |
| Outer Sat, WCS + OOB | 19 | -49 | -96 |
| Inner Sat, WCS + OOB | 18 | -48 | -95 |

**Exhibit B: WCS Band Pass Filter Response Plots**

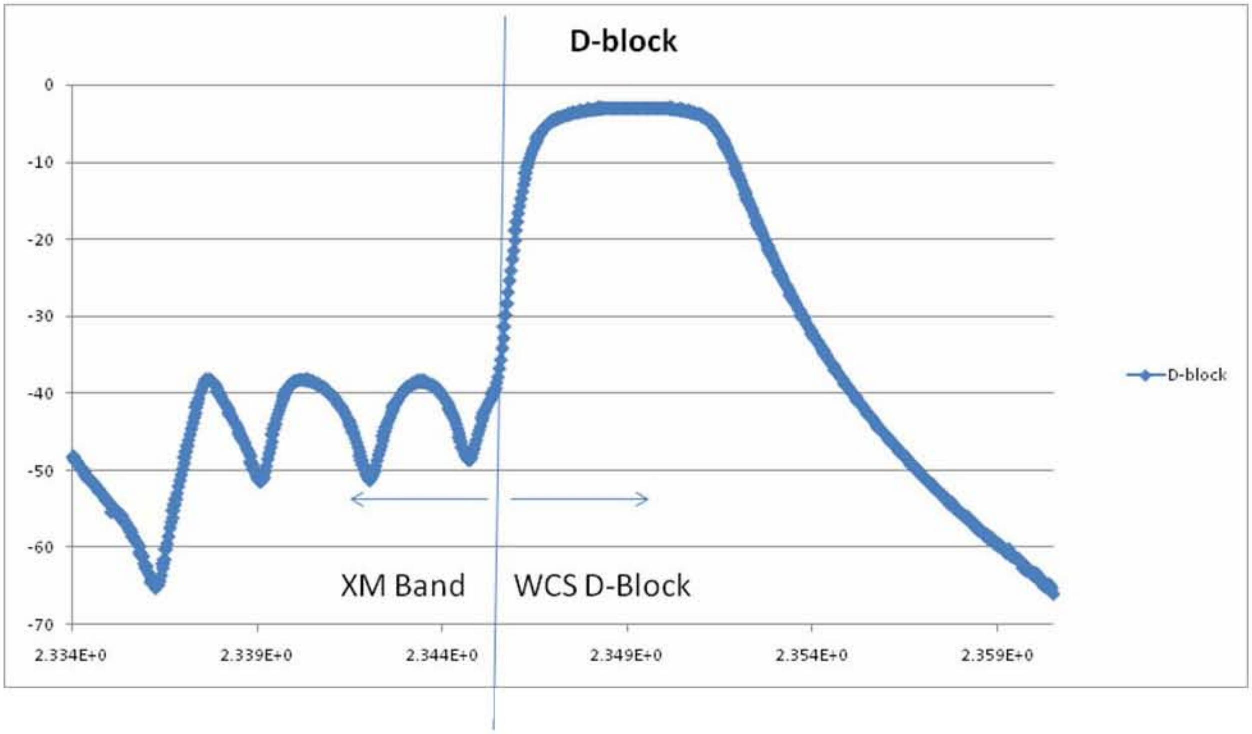


**Figure 8: D-block BPF Filter Response**

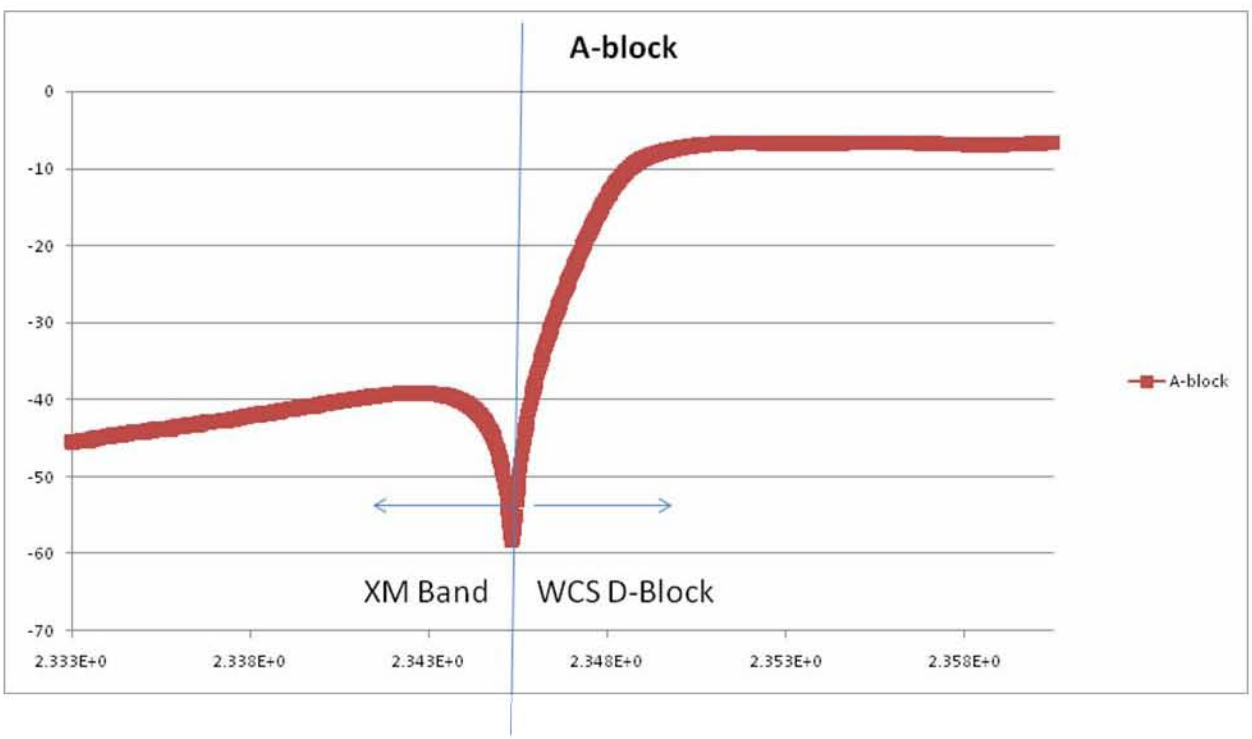


**Figure 9: A-upper Block BPF Filter Response**